

## CELLUAR TELEPHONE WITH IMPROVED MECHANICAL DESIGN

## BACKGROUND OF THE INVENTION

## FIELD OF THE INVENTION

The present invention relates in general to cellular telephones. More  
5 particularly, the present invention relates to clamshell style cellular telephones.

## DESCRIPTION OF RELATED ART

In the past decade the use of cellular telephones has increased to the point that  
a high percentage of people in many societies carry cellular telephones with them at  
all times and enjoy the ready access to telephonic communications that the cellular  
10 telephones provide. Recently, there is an interest in enhancing the functionality of  
phones, so that users who already carry cellular telephones will be able to make  
greater use of them. In this vein, and in anticipation of increased cellular network  
bandwidth, recently cameras have been integrated into cellular phones, in order to  
allow user to transmit still pictures and video.

15 Cellular telephones having a statically mounted camera facing the front of the  
cellular telephone, allow users to take a picture of themselves while operating controls  
on the front of the telephone. However simultaneously operating controls on the front  
of the telephone, while taking a picture of a scene in front of the user is ergonomically  
problematic.

20 One ergonomically advantageous cellular telephone is the clamshell type.  
Clamshell type cellular phones are quite small when folded allowing them to be easily  
stowed, while at the same time when opened up to an obtuse angle are long enough to  
bridge the distance between the ear and mouth. Recent models of clamshell type  
cellular telephones have small displays on the outside of the top half that are viewable

when the telephone is closed. Such small displays are used to display caller ID information to the user without the user having to open the telephone, thus allowing the user to selectively answer calls without opening the telephone, and allowing the telephone to be configured to automatically answer incoming telephones when the user opens the telephone. However, the use of such displays is limited since they are not visible when the telephone is opened and the user is facing the main display, and keyboard.

### BRIEF DESCRIPTION OF THE FIGURES

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

FIG. 1 is a cut away front view of an embodiment of a clamshell cellular telephone including a pivoting head in a first position;

FIG. 2 is a cut away side view of the clamshell cellular telephone shown in FIG. 1;

FIG. 3 is a cut away side view of the clamshell cellular telephone shown in FIGS. 1-2 with the pivoting head in a second position;

FIG. 4 is a graph including plots of profiles of a cam and complementary follower included in the cellular telephone shown in FIGS. 1-3;

FIG. 5 is a fragmentary perspective view of the follower represented in FIG. 4;

FIG. 6 is a top view of a lower part of an upper half of the cellular phone shown in FIGS. 1-3; and

FIG. 7 is a schematic perspective view of a second embodiment cellular telephone.

## DETAILED DESCRIPTION

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore,  
5 specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the  
10 invention.

The terms a or an, as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language). The term  
15 coupled, as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically.

FIG. 1 is a cut away front view of an embodiment of a clamshell cellular telephone 100, and FIG. 2 is a cut away side view of the clamshell cellular telephone 100 shown in FIG. 1. The cellular telephone 100 comprises a lower half 102 that  
20 includes a keypad 104, and encloses electrical circuits on one or more circuit boards (not shown). An antenna 202 attaches to the lower half. The cellular telephone 100 further comprises an upper half 106, that is coupled to the lower half 102 by a hinge 108. The hinge 108 includes a hinge axis 109. The upper half is known in the art as the 'flip'.

The upper half 106 comprises a lower part 110 that is coupled to the lower half 102 of the cellular telephone by the hinge 108, and a pivoting head 112 that is coupled to the lower part 110 by a pivot mechanism 114. A main display 116 for the cellular telephone 100 is located at a surface 117 of the lower part 110 of the upper half 106. The pivoting head 112 includes an auxiliary display 118, an earpiece speaker 204, and a camera 122. The auxiliary display 118 is located on a first side 120 of the pivoting head 112, and the earpiece speaker 204, and the camera 122 are located adjacent a second side 206 of the pivoting head 112. The pivoting head 112 includes an acoustic port 208 proximate the earpiece speaker 204 on the second side 206. In use a user positions the cellular telephone 100, so that the acoustic port 208 is adjacent the user's ear. The second side 206 of the pivoting head 112 also includes an aperture 210 through which the camera 122 views a scene in the surroundings of the cellular telephone 100.

Generally, when the user is entering data or commands and/or configuring the cellular telephone 100, the cellular telephone 100 will be positioned so that the keypad 104 and the main display 116 face the user. This position facilitates operating the keypad 104 to control the cellular telephone 100, and viewing the main display 116 in order view information displayed on the main display 116 in response to keystrokes.

In the position shown in FIG. 2, the pivoting head 112 is oriented so that the auxiliary display 118 faces in a direction opposite to the direction the main display 116 faces. When the auxiliary display 118 faces away from the main display 116 and the cellular telephone 100 is closed by bringing the upper half 106 along with the pivoting head 112 to the lower half 102, the main display 116 will be concealed, but

the auxiliary display 118 will be exposed and is then suitably operated to display caller ID information, or text message information to the user without the user having to open the cellular telephone 100. Furthermore, in the configuration shown in FIG. 2, with the cellular telephone 100 open, the earpiece speaker 204 is suitably positioned for conducting telephone conversations, and the camera 122 is suitably oriented to take a picture of the user if the user holds the cellular telephone 100 in front of his or her face.

FIG. 3 is a cut away side view of the clamshell cellular telephone 100 shown in FIGs. 1-2 with the pivoting head 112 in a second position. The configuration shown in FIG. 3 is the same as that shown in FIG. 1 and different from that shown in FIG. 2. In the configuration shown in FIG. 3, the pivoting head 112 is oriented so that the auxiliary display 118 faces in the same direction as the main display 116. In this orientation, the camera 122 faces in a direction opposite to the direction that the main display 116 faces. Thus if the user holds the telephone 100 so that the keypad 104, and the main display 116 faces him or her, then the camera 122 will be oriented to view the same scene that is viewed by the user looking beyond the telephone 100. In this configuration the main display 116 is suitably operated to display the scene captured by the camera 122, and the auxiliary display 118 is suitably operated to display a text message as it is composed by the user using the keypad 104. The user can readily compose a text message or notation that is to be associated with a picture taken by the camera 122 while taking the picture. The picture along with the message or notation is then suitably stored in the cellular telephone 100, or transmitted through a cellular network (not shown).

Thus, depending on the orientation of the pivoting head 112, the camera 122 can be oriented to take a picture (or video) of the user while the user operates the keypad 104 (e.g., to control the camera), or to take a picture (or video) of a scene in front of the user while the user operates the keypad 104.

5           As indicated in FIGs. 2-3 the pivot mechanism 114 includes a pivot axis 212. The pivot axis 212 is normal to, though does not necessarily intersect, the hinge axis 109. The lower part 110 of the upper half 106 of the cellular telephone 100 includes a longitudinal axis 214. The longitudinal axis 214 is parallel to the plane of the main display 116, and perpendicular to the hinge axis 109. In the perspective of FIGs. 2-3,  
10       the pivot axis 212 is rotated in the counterclockwise direction by an acute angle of alpha relative to the longitudinal axis 214. Setting the pivot axis 212 at an acute angle relative to the longitudinal axis 214 allows the pivoting head 112 to be oriented to face different azimuthal angles about the longitudinal axis 214. The pivot axis 212 and the longitudinal axis 214 define a plane that is perpendicular to the first 120, and  
15       second 206 sides of the pivoting head 112. The angle between the pivot axis 212 and the longitudinal axis 214 is suitably less than 20 degrees, and more suitably less than 15 degrees. This angle can be adjusted to accommodate different styling of the cellular telephone 100. The first side 120 (including the auxiliary display 118), and the second side 206 of the pivoting head 112 are inclined toward each other so that the  
20       pivoting head 112 is tapered to a smaller width toward the top of the telephone 100. Specifically, in the perspective of FIGs. 2, with the pivoting head 112 oriented as shown, the first side 120 is tilted clockwise by the acute angle alpha relative to the pivot axis 212, and the second side 206 is tilted counterclockwise by the acute angle alpha relative to the pivot axis 212. By virtue of the above described tilt of the pivot

axis 212 relative to the longitudinal axis 214 by  $\alpha$ , and the tilt of the two sides 102, 206 of the pivoting head 112 by the angle  $\alpha$  in opposite directions, whichever of the sides 120, 206 of the pivoting head 112 is oriented toward the front of the telephone 100 (main display 116 side) will be parallel with the surface 117 of the lower part 110 including the main display 116, and owing to the transverse dimensioning of the pivoting head 112, and central placement of the pivot mechanism 114, will be flush with surface 117 of the lower part 110. Additionally the upper half 106 will present the same profile to the lower half, allowing the cellular telephone to be closed whether the pivoting head 112 is oriented as shown in FIGs. 1,3 or as shown in FIG. 2. The lower half 102 comprises an inside surface 105 which comes to the upper half 106 when the upper half 106 is rotated toward the lower half about the hinge 108.

Arranging the auxiliary display 118, parallel to the main display 116 is desirable from an ergonomic standpoint and also allows the auxiliary display 118 to be operated as an extension of the main display 116. Additionally whichever side 120, 206 of the pivoting head 112 faces away from the main display 116 will be oriented at an angle of two times  $\alpha$  relative to the longitudinal axis 214 of the upper half 106. By selecting angles of the sides 120, 206 of the pivoting head 112, and tilting the pivot axis 212, as described above a tapered design of the pivoting head 112 is achieved.

Alternatively, the pivot axis 212 is arranged parallel to the longitudinal axis 214, and parallel to the sides 120, 206 of the pivoting head 112.

The pivot mechanism 114 comprises a pinion 124 that is integrally molded with the lower part 110 of the upper half 106. The pinion 124 extends upward from a

top surface 126 of the lower part 110, into a hole 128 in a bottom surface 130 of the pivoting head 112. An annular, axially acting cam surface 132 is integrally formed on top surface 126 of the lower part 110 surrounding and concentric with the pinion 124. An annular follower surface 134 is integrally formed on the bottom surface 130 of the pivoting head 112 surrounding and concentric with the hole 128. The annular follower surface 134 has a profile that is complementary to that of the cam surface 132 and axially engages the cam surface 132. A hole 136 that extends axially through the pinion 124 serves as an electrical feed through for one or more narrow strips of flexible printed circuitry 138 used to conduct signals into and out of the pivoting head 112. The narrow strips of flexible printed circuitry 138 are electrically coupled to the auxiliary display 118, to the earpiece speaker 204, and to camera 122. Integrated circuits, such as a display driver for the auxiliary display 118 are optionally included in the pivoting head 112.

Alternatively, the pinion 124 is attached to the pivoting head 112, and the hole 128 is formed in the lower part 110 of the upper half 106.

FIG. 4 is a graph including plots of the profiles of the cam surface 132, and follower surface 134 as a function of rotation angle. A first plot 402 shows the profile of the cam surface 124 and a second plot 404 shows the profile of the complementary follower surface 126. The profile 402 of cam surface 132 is smoothly varying in height, and resembles two cycles of a sinusoid. As shown in FIG. 4 the profile of the cam surface 132 includes a first peak 406, a first valley 408, a second peak 410, and a second valley 412. Similarly, the profile of the follower surface 134 includes a first peak 414, a first valley 416, a second peak 418, and a second valley 420. FIG. 5 is a



fragmentary perspective view of the follower represented in FIG. 4 and shown in FIGs. 1-3.

Referring again to FIGs. 1-3, the pivot mechanism 114 further comprises a coil spring 140 that is positioned around the pinion 124, and sits on an annular spring seat 142 formed in the pivoting head 112 around the hole 128. A spring retainer in the form of a snap washer 144 that fits in an annular groove 146 in the pinion 124 holds the spring 140 in compression, setting up a spring force that urges the pivoting head 112 toward the lower part 110 of the upper half 106 and causing the follower surface 134 to engage the cam surface 132. Given the profiles of the cam surface 132, and follower surface 134 described above and shown in FIGs. 4-5, there are two relative orientations of the pivoting head 112, and lower part 110 that minimized the compression of the coil spring 140, and are consequently stable. One stable relative orientation is that depicted in FIGs. 1, 3 and another is depicted in FIG. 2. Referring to FIG. 4, in one stable configuration the first peak 406 of the cam surface 132 is aligned with the first peak 414 of the follower surface 134. In the other stable configuration the first peak 406 of the cam surface 132 is aligned with the second peak 418 of the follower surface 134. Thus, the coil spring 140, cam surface 132, and follower surface 134 serve to bias the pivoting head 112 to one of the two orientations.

According to an alternative embodiment the cam surface 132, and follower surface 134 are eliminated so that the pivoting head 112 is not biased to any particular orientation. Although certain particular details of the pivot mechanism 114 are illustrated in FIGs. 1-5, different type pivot mechanisms are alternatively used.

In order to prevent the pivoting head 112 from being turned repeatedly in the same direction, and overstressing the flexible printed circuitry 138 a rotation stop mechanism is provided. FIG. 6 is a top view of a lower part of an upper half of the cellular phone shown in FIGs. 1-3 highlighting parts of the rotation stop mechanism.

5 As shown in FIGs. 1, 6 the rotation stop mechanism comprises a stop peg 148 that depends from the pivoting head 112. As the pivoting head 112 rotates, the stop peg 148 passes through a first arcuate groove 150, and a second arcuate groove 152 formed in the top surface 126 of the lower part 110 of the upper half 106. The first arcuate groove 150 is closed at one end 602 (i.e. does not go all the way through the  
10 depth of the lower part 110) so as to stop the rotation of the pivoting head 112. The second arcuate groove 152 is also closed at one end 604, so as to stop the rotation of the pivoting head 112. The length of the arcuate grooves 150, 152 is set to allow the pivoting head 112 to rotate through about 180 degrees. The length of the arcuate grooves 180 can be extended to allow a rotation range that exceeds 180 degrees. In  
15 such a case the cam surface 132 and follower surface 134 will, nonetheless bias the rotation of the pivoting head 112 to two orientations that are 180 degrees apart. Although, a particular form of stop mechanism is shown in FIGs. 1,6, alternatively another type of stop mechanism is used.

In order for a processor (not shown) of the cellular telephone 100 to operate in  
20 a manner responsive to the orientation of the pivoting head 112, the telephone 100 comprises an orientation detection system. As shown in FIG. 1 the orientation detection system comprises a hall effect switch 154 disposed in the lower part 110 proximate the pivoting head 112, and a magnet 156 disposed in the pivoting head 112 proximate the lower part 110. When the pivoting head 112 is oriented as shown in

FIGs. 1, 3 the hall effect switch 154 and the magnet 156 will be in close proximity to each other, allowing the hall effect switch 154 to sense the proximity of the magnet, and by that sense the orientation of the pivoting head 112. For certain applications it is appropriate to control the operation of the auxiliary display 118 based on the orientation of the pivoting head 112. For example if the pivoting head 112 is oriented such that the auxiliary display 118 faces the same direction as the main display 116, the auxiliary display is suitably used to display information based on user input entered through the keypad 104. On the other hand, if the pivoting head 112 is oriented such that auxiliary display 118 faces away from the main display 116, then the auxiliary display 118 is suitably used to display caller ID information. Alternatively, the orientation detection system is not used, and the operation of the auxiliary display 118 is based on the state of execution of one or more programs running on the processor of the cellular telephone 100. For example when the cellular telephone 100 is receiving an incoming telephone call, the auxiliary display 118 is used to display caller ID information, and when the user puts the cellular telephone 100 in picture taking mode, the auxiliary display 118 is used to echo text messages, or annotations being entered by the user, or to display information related to the functioning of the camera 122.

As used in this description the term acute angle means an angle less than ninety degrees including zero degrees.

FIG. 7 is a schematic perspective view of a second embodiment cellular telephone 700. The second cellular telephone 700 comprises an upper half or 'flip' 702 coupled to a lower half 704 by a hinge 706. The flip 702 comprises a lower part 708 that is coupled to the lower half 704, and a pivoting head 710 that is coupled to

the lower part 708 of the flip 702 by a pivot mechanism schematically represented at 712. The pivoting head 710 comprises an earpiece speaker 714, and a camera 716 located on a first side 718 of the pivoting head 710, and a display 720 (indicated by dashed lines) on a second side 722 of the pivoting head 710 opposite from the camera 716.

While exemplary embodiments of the invention have been illustrated and described, it will be clear that the invention is not so limited. Numerous modifications, changes, variations, substitutions, and equivalents will occur to those of ordinary skill in the art without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is: